# A BAYESIAN NONPARAMETRIC APPROACH TO GEOGRAPHIC AND TWO-DIMENSIONAL REGRESSION DISCONTINUITY DESIGNS

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Geographical and two-dimensional regression discontinuity designs (RDDs) extend the classic, univariate RDD to multivariate, spatial contexts. We propose a framework for analyzing such designs with Gaussian process regression. This yields a Bayesian posterior distribution of the treatment effect at every point along the border, allowing for impact heterogeneity. We can then aggregate along the border to obtain an overall local average treatment effect (LATE) estimate. We address nuances of having a functional estimand defined on a border with potentially intricate topology, particularly with respect to defining the target estimand of interest. The Bayesian estimate of the LATE can also be used as a test statistic in a hypothesis test with good frequentist properties, which we validate using simulations and placebo tests. We demonstrate our methodology with a dataset of property sales in New York City, to assess whether there is a discontinuity in housing prices at the border between school districts. We also discuss application of this method to the context of treatment as a function of two forcing variables, such as falling below a threshold for either a reading or math test.



Dr. Luke Miratrix is an Associate Professor at the Harvard Graduate School of Education and affiliate faculty in Harvard's Statistics department. Miratrix's primary focus is the development and use of modern statistical methods in applied social science contexts. He also directs the Miratrix C.A.R.E.S. lab, a group of students in statistics, education, and elsewhere dedicated to high-quality causal inference research in the social sciences. He focuses on transparently analyzing data, allowing for diverse stakeholder engagement while preserving analytic rigor. His recent work examines best practices for impact evaluation in social science contexts. But Dr. Miratrix also studies machine learning and high-dimensional methodology for text analysis—here, transparency means evaluating how statistical modeling results connect to human measures of meaning. While primarily focused in education, other projects involve elections and voting systems, media analysis, behavioral political science, regulatory agency effectiveness (e.g. OSHA), pre-trial risk assessment systems & criminal justice reform, and human-computer interactions. Dr. Miratrix received his Doctorate in Statistics from the University of California, Berkeley in Spring 2012. He holds a Master's in Computer Science from M.I.T., a B.S. in Computer Science from the California Institute of Technology, and a B.A. in Mathematics from Reed College. He also taught high school for 7 years.

## Colloquium Access Information:

Friday, 4/7/2023, 11am ET
https://tinyurl.com/rmme-Miratrix
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